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REPORT

Design Report

Middle Peninsula Landfill - SWP No. 572

Submitted to:

Middle Peninsula Landfill
3714 Waste Management Way
Glenns, Virginia 23149

Submitted by:

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Project No.: 20-136835

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1.0 INTRODUCTION

This Design Report has been prepared for the Middle Peninsula Landfill (Facility). The landfill operates as a municipal solid waste landfill under Virginia Solid Waste Permit #572. Golder Associates Inc. has prepared this Report for Waste Management Disposal Services of Virginia, Inc. (Waste Management).

1.1 Site Description

The Middle Peninsula Landfill is located approximately 1.5 miles north of the unincorporated community of Adner, VA on U.S. Highway 17 in Gloucester County, Virginia. The Facility is owned by the County of Gloucester and is operated by Waste Management. The Facility includes a lined disposal area; support facilities, including a scale house, truck scale, maintenance building, and storage compound; and the environmental controls and monitoring systems required for a municipal solid waste landfill.

The Facility is permitted with two disposal areas: Disposal Area A (approximately 165 acres) and Disposal Area B (approximately 60 acres). Disposal activities have been ongoing at Disposal Area A since the landfill became active in June 1995. Once Disposal Area A has reached final grades, Disposal Area B will be constructed and filled.

Two intermittent streams drain the southern portion of the site and flow into Woods Mill Swamp, which is located approximately 2,500 feet from the southern edge of the site and drains into the Poropotank River. Two additional intermittent streams drain the northern portion of the site and flow approximately 12,000 feet into the Poropotank River.

1.2 Permit Amendment Information

As part of this Major Permit Amendment (July 2021), Waste Management desires to increase the daily tonnage of the landfill and to rename the site sedimentation basins. Waste Management is requesting an increase in their daily disposal limit from 2,000 tons per day (tpd) to a maximum daily intake rate of 4,000 tpd, with an annual maximum disposal limit of 693,000 tons per year (tpy), as stated in the attached Host Agreement with the County of Gloucester, Virginia. The proposed modifications to the site sediment basins will change neither the design nor operation and is for administrative purposes only.

1.3 General Facility Information

Operator:
Waste Management Disposal Services of Virginia, Inc.
Vince Jamison, Sr. District Manager
Middle Peninsula Landfill
3714 Waste Management Way
Glenns, Virginia 23149
(804) 693-5109

Permittee:
Waste Management Disposal Services of Virginia, Inc.
Middle Peninsula Landfill
3714 Waste Management Way
Glenns, Virginia 23149
(804) 693-5109

Owner/Lessor: County of Gloucester
P.O. Box 329
Gloucester, Virginia 23061
Director of Public Works
(804) 693-6269

Engineer: Golder Associates Inc.
Ron DiFrancesco, P.E.
2108 West Laburnum Ave., Suite 200
Richmond, Virginia 23227
(804) 358-7900

1.3.1 Site Acreage

The property area is approximately 510 acres, and the ultimate lined landfill area is approximately 230 acres. The landfill is divided into two disposal areas, designated Disposal Area A and Disposal Area B. Disposal area A consists of approximately 165 acres, and will be filled first. Disposal Area B is approximately 60 acres, and will be filled once Disposal Area A has reached capacity. If required, disposal areas A and B may be operated simultaneously.

1.3.2 Landfill Capacity and Life Expectancy

Disposal Area A provides approximately 34 million cubic yards of disposal volume and Disposal Area B provides approximately 9 million cubic yards of disposal volume. Approximately 15 percent of the landfill capacity is expected to consist of daily and intermediate cover. The landfill expects to receive a maximum of 4,000 tpd with an annual maximum disposal limit of 693,000 tpy, which is approximately 2,423 tpd for 286 days per year. Based on these assumptions and the bottom liner and final cover dimensions, the Facility is expected to have capacity through Fall of 2055.

1.4 Prior Approvals

The landfill has previously received Part A and Part B approvals. The Part A approval letter is included as Attachment 1 and the Host Agreement for the increase in tonnage is included as Attachment 1.a to this Design Report amendment.

2.0 SITE FEATURES

2.1 Security

The Facility is bordered by U.S. Highway 17 and Virginia Route 601, as well as numerous private properties, which effectively controls vehicular traffic to the site. Where the existing geographical barriers are deemed insufficient for security, a chain-link fence or other barrier will be erected. Vegetative screenings have been planted and are established along the landfill perimeter.

To prevent unauthorized access, gates will be kept locked unless an attendant is on duty. Fencing, gates, locks, and berms will be inspected and maintained.

The operators will be equipped with mobile radios or cellular phones to maintain contact with the office personnel.

2.2 Traffic Control

The permanent paved entrance (Waste Management Way) provides access to the Facility from U.S. Highway 17. An all-weather access road provides access to the site infrastructure area. Gravel perimeter roads provide access to the active landfill and stormwater basins. Traffic maintenance will be performed by site personnel should rutting or settlements occur, thus ensuring all-weather access to the active areas of the Facility. Consideration for standard licensed vehicles will be made when constructing and maintaining all internal roads.

Traffic routing on the site will be directed by signage and operations personnel. Vehicles enter and exit the Facility though the entrance off of U.S. Highway 17. The existing 30-ft wide, 1,000-ft long entrance road has sufficient width to allow safe passage of users. All vehicles are required to stop at the Facility attendant building at the scale area to be inspected and weighed. Beyond the entrance road, the access road is approximately 2,200-ft long until it reaches the haul road to the active working face.

Processing incoming vehicles and inspecting loads typically takes about 1 to 3 minutes on average. Processing activities are conducted by the Facility attendant. Using the upper processing time of 3 minute per vehicle, the Facility can process approximately 20 vehicles per hour. Vehicles typically include self-loading, municipal garbage trucks and transfer trailers with a maximum average waste load of twenty tons.

A traffic queueing analysis and calculations to determine the minimum active working face size were completed to demonstrate the Facility can handle the anticipated traffic and waste volumes. These calculations are included as Attachment 7.

The queueing analysis first examined the capacity of the entrance road from U.S. Highway 17 to the attendant building and scale to determine if the entrance road had sufficient length for incoming vehicles during and after a peak period. It was assumed the Facility would experience 2 hours of peak traffic from 7:00 am to 9:00 am at the requested maximum daily disposal limit of 4,000 tpd or 421 tons per hour based on an 9.5-hour workday. The analysis assumed that after 9:00 am, the Facility would experience incoming vehicles at the permitted daily average tonnage rate of 2,400 tpd or 253 tons per hour until 4:30 pm. For the purpose of the analysis, it was assumed that the incoming waste vehicles would be municipal waste transfer trailers.

The entrance road queueing analysis shows that a maximum of 3 transfer trailers would need to be staged on the entrance road during peak traffic. The required queueing length along the entrance road was determined to be approximately 150 feet. The available entrance road length from the entrance to the attendant building and scale is approximately 1,000 feet. As demonstrated by the analysis and the measured available entrance road length, there is sufficient queueing capacity along the Facility entrance road to safely stage and accommodate peak delivery rates without impacting U.S. Highway 17.

The next queueing analysis examined the capacity of the interior access road from the attendant building to the working face to determine if the access road had sufficient length to stage incoming vehicles during the same peak

period and whether there was sufficient time in the working day to unload all received vehicles. For this analysis, the lower processing time of 1 minute per vehicle was used in the entrance road queuing analysis and the end processing time was used as the arrival time. The analysis assumed that active working face could accommodate 6 unloading areas simultaneously based on the minimum working face size determination. It was also assumed that it would take approximately 18 minutes for a vehicle to travel from the scale to the working face, unload, and then exit the working face area.

The on-site vehicle queueing analysis shows that a maximum of 3 transfer trailers would need to be staged during peak traffic. The required queuing length was determined to be 150 feet. The available access road length from the attendant building and scale to the working face is approximately 2,200 feet. As demonstrated by the analysis and the measured available access road length, there is sufficient queueing capacity along the Facility access road to safely stage and accommodate peak traffic without impacting US. Highway 17 and Facility operations.

The requested increase in the daily disposal limit will not require modifications to the Facility infrastructure and is not anticipated to affect existing traffic patterns.

2.3 Shelter

The landfill office is located near the Facility entrance at the truck scale. Operating personnel for the facility have access to lighted, heated shelter and permanent sanitation facilities at the office. Portable sanitation facilities will be provided near the active portion of the landfill.

2.4 Aesthetics

The site is located within a mostly residential and agricultural area along U.S. Highway 17. The Facility is bounded by trees on all sides, including a maintained visual buffer along U.S. Highway 17 and State Route 601. The distance to the closest tree line from the disposal unit boundary is approximately 60 feet.

Noise at the Facility boundary should not be of concern, as the Facility operations will take place at a distance of over 120 feet from the Facility boundary. As can be seen in the table below, the average noise level[1] for the anticipated types of construction equipment is below the 80 decibels (dBA) threshold at 100 feet. The presence of a mixed hardwood/pine tree buffer surrounding the site will act to further attenuate noise generated during Facility operations.

Table 1: Construction Noise Activity Table

Equipment Type	Average A-Weighted Noise Level at 100 feet (dBA, Leq)
Water Truck	78
Bulldozer	79
Haul Truck	78

[1]Field-measured construction equipment noise data were found in Appendix N of the 2007 *Draft Environmental Impact Report for the Port of Los Angeles Container Terminal Project* (http://www.portoflosangeles.org/EIR/TraPac/DEIR/Appendix_N_Noise.pdf).

2.5 Site Benchmarks

Site benchmarks have been established and are shown on Drawings 5 and 6 of the Design Plans. The benchmarks are identified as the top of the casing on two existing groundwater monitoring wells.

Table 2: Site Benchmarks

ID	Ground Elevation	Northing	Easting	Latitude	Longitude
MW-11D	60.90	3715377.76	12029599.76	N 37° 30' 42.64"	W 76° 36' 54.27"
MW-18D	89.16	3719457.27	12026124.36	N 37° 31' 23.65"	W 76° 37' 36.39"

3.0 SITE DEVELOPMENT

Waste Management shall be responsible for the stake-out of all construction for the project in accordance with the design plans. Waste Management may utilize subcontractors, as deemed appropriate, for specific functions related to construction and engineering services. Waste Management will provide all surveying required to layout the construction work from the horizontal and vertical reference points established by Waste Management's Engineer. Waste Management will provide all engineering personnel, materials, equipment, and labor required to satisfactorily stake-out the project.

All reference points provided by Waste Management's Engineer shall be carefully protected. The Contractor shall notify Waste Management's Engineer a reasonable time in advance of the locations at which they intend to work, to allow for layout of the references required with a minimum of inconvenience to the Engineer and delay to the Contractor.

Waste Management will employ an Engineer to provide quality assurance services during construction. As-built drawings will be prepared during construction of the on-site roads, site infrastructure, erosion and sedimentation control facilities, disposal cells, etc. Construction documentation drawings will verify that the site's facilities were constructed substantially in accordance with the plans and specifications upon which the permit was issued.

3.1 Landfill Phase/Cell Development

The phasing for Middle Peninsula Landfill is designed to allow for flexibility in construction scheduling of the site with uninterrupted landfill operations. The phasing requires the stockpiling of soil and geosynthetic materials at the site. The stockpiling of geosynthetic materials will be near the site infrastructure area or as designated by Waste Management. The operational phases are designed to allow flexibility in construction scheduling to compensate for any variation of incoming waste intake. The disposal areas for operations in each phase are shown in Table 2 below. Details of each Phase’s construction are included in Drawings 16 through 24 of the Design Plans.

Table 3: Landfill Phasing Table

Fill Phase	Constructed Cells	Lined Area (Ac)	Capacity (CY)	Life (Years)
Landfill Area A				
1-3	1-11	101.4	10.9 million	21.0
4	12-13	16.5	3.4 million	3.8
5	14-15	16.3	5.1 million	5.9
6	16-17	15.7	3.9 million	5.0
7	18-19	15.7	4.3 million	5.5
8	N/A	0	6.7 million	8.4
Landfill Area B				
9	20-23	39.2	1.5 million	1.8
10	24-26	19.8	3.0 million	3.7
11	N/A	0	4.2 million	5.2

Notes:
1. Supporting calculations for the capacity and estimated life of each phase were determined by computer-aided drafting (CAD) software.
2. Fill Phases 8 and 11 consist of filling atop previously constructed cells. No new cell construction is included in these fill phases.

A substantial amount of materials are required for development, operation, and final capping of the landfill site. Material will be needed for many activities, including base grade preparation, landfill liner, leachate drainage, landfill gas venting and extraction, berm construction, landfill capping and final cover, construction of site infrastructure, daily cover, and intermediate cover.

3.2 Borrow and Stockpile Estimates

The site currently has a net soil deficit through the closure timeframe; however, off-site soil is readily available to the Facility. There are and have been various borrow sources of clean soil fill, which the Facility uses to provide for operational and intermediate cover, and for various construction projects on the site (e.g., road building, cell construction, etc.).

The total remaining soil needs for the site include clean soil fill for landfill operations, future cell construction, miscellaneous site improvements, and final closure. The total net soil deficit for the Facility is approximately 938,275 cubic yards (CY).

This anticipated volume of soil required over the remaining life of the Facility is expected to come from available on-site soils from cut sections, incoming landfill users (i.e., acceptable low level contaminated soils and other clean fill materials), future permitted borrow areas, and available off-site commercial sources.

The available on-site soil sources include existing soil cut sections which, as of December 2020, have a remaining volume of approximately 1,216,410 CY. In addition to these soils cut sections, the borrow sources are estimated to provide approximately 3,282,360 CY of soil. Approximately 636,900 CY will be used for future development and the remaining soil will be used for operational cover and cap construction. Additional soil needed for constructing the final cover system will be purchased from available off-site commercial sources at the time it is needed.

4.0 LANDFILL UNIT DESIGN

4.1 Liner Foundation

The Middle Peninsula Landfill has been designed and will be constructed as a secure containment facility incorporating a composite liner and leachate collection system. The permitted base grade (base of composite liner system) for Middle Peninsula Landfill and Recycling Facility are designed above the composite high phreatic surface uppermost aquifer developed for the Part A Solid Waste Application.

4.1.1 Surface Exploration Data

A series of borings and soil tests were performed as part of the original permit, and provide an adequate representation of the site's soil stratigraphy and mechanical properties. The permitted base grades for the Facility are designed to be above the composite high phreatic surface uppermost aquifer developed for the Part A Solid Waste Application.

4.1.2 Laboratory Data

Material properties' testing has been performed on both disturbed and undisturbed samples of soil obtained from the site during the investigation in support of the Part A application. The testing included classification, specific gravity, moisture-density relationships, remolded and undisturbed permeability, triaxial compression, and consolidation testing. The results of these tests were presented in the Part A Permit Application. The results of the tests have been used in this report to evaluate foundation strength and bearing capacity, settlement potential, slope stability, and facility constructability.

4.1.2.1 Settlement Potential

An analysis was previously performed (Rust, 1993) to determine both total and differential post-development settlement within the landfill. The calculations are based on the design subgrade elevations and the final development grades of the landfill surface. The maximum total settlements of the base grade under the highest fill area (the middle of the landfill) were estimated to be about 4.19 feet in Disposal Area A and 2.8 feet in Disposal Area B. Settlement of the base grade under the perimeter of the landfill in the vicinity of the leachate sumps is estimated to be less than 2.28 feet. The greatest differential settlement within any given individual phase between the high point and the sump is calculated to be 2.8 feet based on the maximum and minimum expected settlements. This settlement is expected to occur over an extended period of time (the life of the landfill) as loading to the area occurs with fill operations.

The phases are approximately 1,200 feet in length. Three feet of differential settlement would reduce the grade of the subgrades by approximately 0.25 percent, which will not significantly affect gradients within the phases. A calculation was previously performed that provided the minimum required leachate collection pipe slope, which indicated that the leachate collection pipes could have a slope as flat as 0.4 percent and still convey the maximum

expected leachate flows during the entire life of the landfill. The settlement analysis from the original permit is included in Attachment 2 of this Design Report amendment.

4.1.2.2 Bearing Capacity and Stability

A bearing capacity analysis was previously performed to demonstrate that the bearing capacity of the underlying soils will not be exceeded by the expected loading by the landfill (Rust, 1993). The ultimate bearing capacity of the subsurface soils is estimated to be 52,773 pounds per square foot (psf) and the loading of the landfill is expected to be approximately 25,575 psf. These values yield a factor of safety against bearing capacity failure of 2.06. The original permit calculations for bearing capacity are included in Attachment 2 of this Design Report amendment.

Slope stability was evaluated as part of the original permit. The evaluation was conducted for circular failure and sliding block failure methods. The design modifications are not expected to significantly decrease the stability of the bottom liner or final grades. Attachment 3 of this Design Report presents the slope stability analysis from the original permit.

4.1.2.3 Bottom Heave or Blow-out

Bottom heave is upward movement of the *in-situ* soils, resulting in the rise of the ground surface. This movement is caused by unloading, due to the excavations, resulting in elastic rebound of the underlying soil. Excavations to establish base grade elevations at the site will generally be no greater than 20 feet below the existing grade. Elastic rebound resulting from removal of 20 feet of soil will be less than 1 inch and will likely have no effect on construction of the Facility. However, the potential for bottom heave will be visually monitored during construction.

Blow-out of the bottom or sides of an excavation can be caused by excessive hydrostatic pressure acting upward against a soil layer or particle. Blow-out will occur when the effective stress in the soil is equal to the neutral stress. When blow-out occurs, the hydraulic gradient must be approximately equal to 1.0. Vertical hydraulic gradients calculated in the Part A Permit indicated hydraulic gradients of 0.01 to 0.04. These gradients are significantly less than what would be required to produce blow-out. Therefore, blow-out of the bottom of the excavation is not a concern.

4.1.2.4 Construction and Operational Loading

The calculation titled *Base Grade Stress during Construction*, contained in Attachment 4 to this Design Report amendment, indicates that there will be adequate protection from installation and operation activities.

4.2 Limiting Site Characteristics

No utilities are known to be under the Facility. Adjacent utilities have been identified to the west of the disposal area, and these are indicated on the *Existing Conditions Plan* of the Design Plans. No open dumps, unpermitted landfills, or lagoons are known to exist on the site.

4.3 Liner System

Landfilling is on-going at the site under Solid Waste Permit No. 572. Middle Peninsula Landfill is being constructed as a secure solid waste containment facility incorporating a composite liner system that meets or exceeds the requirements of 9VAC20-81-130.J.1. Cells 1 through 11 were constructed with a composite liner system consisting of the following components (from the top down):

- 18-inch granular leachate drainage layer with permeability greater than $5x10^{-2}$ centimeters per second (cm/s)
- 16-ounce per square yard (oz) non-woven geotextile cushion
- 60-mil high-density polyethylene (HDPE) geomembrane
- 2-foot compacted soil layer with permeability less than $1x10^{-7}$ cm/s
- Prepared subgrade

Starting with Cell 12, the lower liner system will be constructed as an approved alternate liner as described in 9VAC20-81-130.J.1.b. This alternate liner system consists of the following layers (from top to bottom):

- 18-inch granular leachate drainage layer with permeability greater than $5x10^{-2}$ cm/s
- 60-mil textured HDPE geomembrane
- GCL with a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec
- 12-inch controlled subgrade

Details for both the existing and alternate bottom liner systems are shown on Drawing 38 and 38A, respectively.

4.3.1 Leachate Drainage Layer

The granular leachate drainage layer consists of an 18-inch-thick, non-carbonate, granular material with a permeability greater than $5x10^{-2}$ cm/s. A network of 8-inch perforated polyvinyl chloride (PVC) leachate collection pipes in Cells 1 through 11 and 8-inch HDPE leachate collection pipes in Cells 12 through 26 drains by gravity into the leachate collection sumps.

4.3.2 60-mil HDPE Geomembrane

The bottom liner geomembrane is constructed from HDPE material, and shall conform to the standards contained in the Technical Specifications. Geomembrane installation shall conform to the practices outlined in the Technical Specifications and the Construction Quality Assurance (CQA) Plan.

4.3.3 Geosynthetic Clay Liner (GCL)

The GCL consists of bentonite encapsulated between two stitched geosynthetic fabrics. The GCL will have a permeability less than or equal to $1x10^{-9}$ cm/s. Prior to placing the GCL, the liner subgrade must be certified by the installer and construction quality assurance (CQA) consultant. Care shall be taken during installation of the GCL to prevent exposure to excessive moisture that may damage the clay material.

4.4 Liner Slopes

The minimum base liner slope is 2% (post-settlement) and the maximum base liner slope is 33% (3H:1V). The liner subgrade shall conform to the requirements of 9VAC20-81-130.J.1.b(2) and the technical specifications.

Based on the results of the settlement analysis (included in Attachment 2 of this Design Report amendment), the base liner slope is expected to function as designed after settlement in all locations.

Engineering analyses for the composite liner system at Middle Peninsula Landfill include the following:

- Slope Stability
- Total Settlement and Differential Settlement Analysis
- Bearing Capacity Calculations
- Liner Stress Calculations

4.4.1 Slope Stability

A side slope veneer stability calculation was performed to analyze the bottom liner system. This was analyzed for a slope section of the base liner at an approximate length of 225 feet. The calculation is provided in Attachment 5 of this Design Report amendment. The analysis concluded that the permitted liner system must have a minimum peak interface friction angle of at least 25.8 degrees with no adhesion. The critical liner section for the internal friction angle of the base liner system is that of the GCL and the subgrade soils. The GCL has an average internal friction angle of 35.3 degrees, and meets the analysis criteria.

4.4.2 Total Settlement and Differential Settlement Analysis

A settlement analysis was prepared as part of the original permit for Areas A and B of the landfill. The purpose of the settlement analysis is to determine the post settlement base grade design slope for the cells in landfill Areas A and B. The settlements in Area A range from 0.0 to 4.19 feet. The settlements in Area B range from 0.28 to 2.8 feet. All post settlement slopes are greater than 2 percent.

4.4.3 Bearing Capacity Calculations

A bearing capacity analysis was performed as part of the original permit. The load distribution was based on the highest load (highest landfill elevation), and was determined using Terzhagi's Equation and influence charts for cohesive soils. Based on the original permit calculations (included in Attachment 2), the landfill exerts a load of approximately 18,660 psf. The permitted bottom liner system was determined to be capable of supporting 68,781 psf, resulting in a factor of safety against failure of 3.69.

4.4.4 Liner Stress Calculations

An evaluation was performed to determine the anticipated stresses on the geosynthetic components of the liner system and to compare these stresses to the inherent tensile strengths of the materials. The calculation titled *Base Grade Liner Self Weight*, found in Attachment 4, indicates that the 60 mil HDPE would not pull out of the anchor

trench or be stressed beyond its yield point. A factor of safety of 1.45 was determined comparing the allowable verses the actual stresses.

4.4.5 Liner Anchor Trench

The base liner system geosynthetics will be installed with a perimeter anchor trench to secure the geosynthetics in place during construction. Due to the anticipated friction angle between the subgrade and the geosynthetic layer immediately above, an anchor trench or horizontal liner run-out is not required for stability; however, one has been included for construction convenience. Anchor trench calculations are provided in Attachment 4 of this Design Report permit amendment.

4.5 Prevention of Exposure

As is detailed in the CQA Plan, the liner will not be exposed to sunlight for a period longer than the manufacturers' recommendations. During the period between when liner construction has been completed and operation of the phase, the exposed drainage material will be repaired as needed and protected from damage due to water erosion, high winds, etc. If the phase is not anticipated to receive waste for a significant period of time, the Facility may use rain tarps or other means to protect the drainage material and reduce leachate production.

5.0 RUN-ON AND RUN-OFF CONTROL SYSTEMS

The stormwater management and storm drain systems were designed to meet or exceed the Virginia Solid Waste Management Regulations, Virginia Department of Conservation and Recreation Division of Soil and Water Conservation Erosion and Sediment Control Regulations, Chesapeake Bay Preservation Act, and Local Ordinances at the time of the original permit. The design and analysis of the systems were prepared using current SCS methods.

Stormwater run-off from undisturbed areas off-site will be controlled by natural drainage features and landfill perimeter berms. The facility is bounded by an unnamed tributary and woods to the east, woods to the south, a residential area, woods and U.S. Route 17 to the west, and an agricultural/residential area and State Route 601 to the north.

5.1 Run-On Control System

No upstream diversion of stormwater run-on from undisturbed areas will be required. Stormwater run-on is precluded around the perimeter of the landfill by the existing, natural topography and the landfill perimeter berms. Most of the stormwater flows away from the landfill being the existing topography slopes away from the perimeter to natural drainage courses. In the few areas where the existing topography slopes toward the landfill, the perimeter berm will prevent run-on from entering the landfill area being the berm is elevated above existing ground in these areas.

Run-on control within the waste management area is controlled by a series of ditches, dikes, and berms. Currently, a system of berms and ditches is used to divert stormwater away from active cells within the waste management boundary.

5.1.1 Design and Performance

The landfill design incorporates the use of standard erosion control measures such as conveyance channels and diversion berms to direct surface run-on away from the active portions of the landfill. Generally, diversion berms direct stormwater to HDPE pipe slopedrains and/or armored downchutes that convey the stormwater down the face of the capped landfill to the site's sediment basins or stormwater management basins. Only water falling directly on the working face or fill areas reaches the active cells. Drawings 16 through 24 show stormwater controls through the remaining landfill development and Drawings 32 through 36A and 39B through 44 show details of the stormwater control structures to be used.

5.1.2 Construction

All drainage structures and channels are to be constructed in accordance with current Virginia Erosion and Sediment Control Standards, Virginia Department of Transportation (VDOT) Drainage Manual, and the Facility's CQA Plan. Designs for non-standard structures should follow current Federal Highway Administration (FHWA) or American Society for Testing and Measurement (ASTM) standards.

5.2 Run-Off Control System

Included in this plan are stormwater calculations that demonstrate the adequacy of the permitted stormwater management systems to adequately handle post-development stormwater events. Supporting calculations for this demonstration are included in Attachment 6 of this Design Report amendment.

5.2.1 Design Rates

Run-off rates for the 2, 25-, and 100-year, 24-hour storm events were determined using the Technical Release No. 55 (TR-55) methodology and were modeled in the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) and Streamline Technology's Interconnected Pond Routing (ICPR).

5.2.2 Stormwater System Design

Run-off from the intermediate and final phases of the capped landfill will be collected in a series of drainage ditches that run along the interior of the intermediate slope control terraces. Typical sections were developed using criteria in the Erosion and Sediment Control Manual. The run-off from the channels is collected in a series of HDPE slopedrain pipes and/or armored downchutes that will safely convey the stormwater to perimeter channels, which drain to the site's sediment/stormwater basins for attenuation and discharge through the Virginia Pollutant Discharge Elimination System (VPDES) permitted outfalls.

A typical diversion berm is a soil berm measuring at least two feet in height that forms a V-ditch channel with a longitudinal slope of one to two percent. The diversion berms divide the drainage area up into areas so that sheet flow does not occur over the landfill surface for more than 24 vertical feet (approximately 72 feet of slope length at (3:1).

The HDPE slopedrain pipes and/or armored downchutes receive stormwater from the diversion berms and convey it down the sideslope of the landfill to the perimeter stormwater channels. The slopedrains will consist of dual-walled HDPE pipe with smooth interior and corrugated exterior and be buried under the final cover soil to facilitate mowing and to prevent water travelling along the axis of the pipe, causing erosion. Water will enter the pipes through engineered drop inlets at the termination of each diversion berm. The armored downchutes will be trapezoidal and consist of 18 inches or grouted class I riprap. At the downstream end of each slopedrain pipe or armored downchute will be an energy dissipation or drop inlet structure that will slow the water down prior to entering the perimeter channel.

The perimeter channels are designed as trapezoidal-shaped channels that are lined with a non-biodegradable geosynthetic lining material that provides adequate erosion protection and supports the development of vegetative lining.

The stormwater and sediment basins at the landfill are designed to receive and attenuate stormwater flows as well as provide trapping and storage for conveyed sediment. The basins are unlined structures constructed partly by excavation and partly by compacted soil berms. The spillway and receiving channel will release run-off at non-erosive velocities. The basin is also equipped with an emergency spillway to pass large flow events without overtopping the embankment.

5.2.3 Drainage Structure Maintenance

Maintenance of the site's drainage structures will include routine inspections as per the Operations Plan to identify areas of erosion, undercutting, or other maintenance needs. Additional inspections may be required after large storm events to check for damage. Specific items to be inspected include:

- Culvert inlets for accumulated sediment or debris
- Diversion berms for erosion and establishment of vegetation
- Downchutes for erosion or deterioration
- Slopedrain pipes for proper anchorage, leaking joints, undercutting
- Vegetation in other areas for proper establishment, need of mowing
- Perimeter channels for erosion and establishment of vegetation
- Energy dissipation and drop inlet structures for integrity and accumulated sediment
- Other temporary controls (e.g., silt fence) for proper function and sediment control

Activities to correct or repair identified deficiencies will be initiated as soon as practical by site operations. Additional time may be required to correct larger deficiencies or if additional drainage structure construction is required. Sediment removed during maintenance or repair activities will be dewatered and used as cover soil on the landfill. For the stormwater basins, the level of accumulated sediment will be monitored on a regular basis through visual inspection. The removal of accumulated sediment can be performed as necessary.

golder.com

Attachment 1.a

Host Agreement for Increase in Tonnage

SECOND CONTRACT AMENDMENT

THIS SECOND CONTRACT AMENDMENT, (this "Second Amendment") is made and entered into this 18th day of May, 2021, by and between the COUNTY OF GLOUCESTER, VIRGINIA (the "County"), a political subdivision of the Commonwealth of Virginia, and WASTE MANAGEMENT DISPOSAL SERVICES OF VIRGINIA, INC., a Virginia corporation ("WMD") (the County and WMD each a "Party" and collectively the "Parties").

RECITALS:

The parties hereto have previously entered into a certain Contract signed by the County on April 6, 1993 and amended by a Contract Amendment dated December 7, 1993 (collectively the "Agreement"), for the development and operation of the Middle Peninsula Landfill and Recycling Facility (the "Facility") in Gloucester County, Virginia, together with associated services for the County.

The parties have found, during the execution of said Contract, that it is desirable to modify and/or clarify certain conditions of the Agreement.

AGREEMENT:

NOW, THEREFORE, in consideration of the mutual covenants contained in the Agreement, and other good and valuable consideration, the receipt and adequacy of which are hereby acknowledged, as well as the agreements hereinafter contained and in accordance with § 17.8 of the Agreement, the parties agree to amend the Agreement effective January 1, 2021 as follows:

1. Section 11.6 of the Agreement shall be deleted and replaced with the following:

> Section 11.6 Disposal Restrictions. Notwithstanding purchase of additional land, WMD shall only utilize the Property for the actual permanent disposal of Solid Waste. WMD's disposal shall not exceed Six Hundred and Sixty Thousand (660,000) tons per calendar year.

2. Request to Exceed Annual Tonnage Cap. The County Administrator is hereinafter empowered to allow additional tonnage of Solid Waste to be disposed at the Facility, not to exceed 5% of the annual limit of 660,000 tons, upon timely request and reasonable justification by WMD. The County Administrator shall not be obligated to grant such request by WMD. WMD shall submit any request to exceed the annual Solid Waste tonnage cap to the County Administrator no later than 30 days prior to the end of the then-current calendar year.

3. County Waste Collection Locations. Exhibit K shall be added to the Agreement and shall read as set forth on Attachment 1 attached hereto.

4. Sections 11.5.1 and 11.5.2 of the Agreement shall be deleted and replaced with the following:

Section 11.5.1 Disposal of Residential Waste. As further consideration, WMD shall dispose, without charge or cost to the County or residents of the County of Gloucester, all residential Solid Waste generated within the County of Gloucester which is delivered to the Facility, convenience centers, or locations set forth in Exhibit K hereto by individuals or delivered to the Facility by private haulers who certify that they have picked up only waste which is entitled to be disposed of without charge pursuant to this Agreement. If WMD obtains evidence of false certification by any such private hauler, WMD may permanently refuse to accept waste from such hauler or require payment of Tipping Fees on future Solid Waste brought to the Facility by such hauler or previously disposed of at the Facility by such hauler.

Section 11.5.2 Disposal of Waste from the County, Schools, Fire and Rescue Organizations or Charitable Institutions. As further consideration, WMD shall dispose, without charge or cost to the County or the County's schools or charitable institutions or fire and rescue organizations, all institutional Solid Waste generated within the County of Gloucester by the County, the County's agencies or offices, the County's public schools or the County's charitable institutions (organizations or institutions qualifying as tax exempt charitable organizations under §5.01(c)(3) of the Internal Revenue Code), or fire and rescue organizations located in Gloucester County which is delivered to the Facility, convenience centers, or locations set forth in Exhibit K hereto by individuals or delivered to the Facility by private haulers who certify that they have picked up only waste which is entitled to be disposed of without charge pursuant to this Agreement. If WMD obtains evidence of false certification by any such private hauler, WMD may permanently refuse to accept waste from such hauler or require payment of Tipping Fees on future Solid Waste brought to the Facility by such hauler or previously disposed of at the Facility by such hauler.

5. Section 11.12.2 of the Agreement shall be deleted and replaced with the following:

Section 11.12.2 Convenience Centers and Green Boxes. Upon Commencement of Commercial Operations, and thereafter until the end of the Primary Term, WMD shall man, operate, and maintain the five convenience centers (the center located at the County's Existing Landfill and each of the remaining four, following their construction). In addition, WMD shall be responsible for transporting Solid Waste from the locations and at the service levels set forth in Exhibit K hereto and arranging for the disposal of these materials. Provided that volumes do not exceed the County Capacity, the services described in this Section 11.12.2 shall be provided by WMD without cost to the County and shall continue until the end of the Primary Term. WMD shall not be responsible for collecting for recycling or processing recyclable materials delivered to the locations set forth in Exhibit K hereto.

6. Special Events. WMD shall provide to the County, without charge or cost to the County or residents of the County of Gloucester, dumpsters and/or collection containers to collect Solid Waste generated at events: (1) organized by the County; (2) open to the general public; and (3) for which the County does not charge money for attendance. Pursuant to the terms of this Paragraph 6, WMD shall provide a reasonable number of dumpsters and/or collection containers sufficient to collect Solid Waste from special event attendees for the duration of the special event.

7. Each Party agrees to take all actions required of it respectively, including timely providing information and documents, to prepare and submit an application for the modification of the Solid Waste Permit issued by the Virginia Department of Environmental Quality (the "DEQ") and currently in effect with respect to the Facility (the "Application"). The Application shall seek to amend the Solid Waste Permit to reflect the disposal restrictions set forth in Paragraphs 1 and 2 of this Second Amendment. WMD shall pay all administrative fees assessed by and/or payable to the DEQ in connection with the Application.

8. If the DEQ denies the Application, this Second Amendment shall be null and void and of no further force and effect.

9. In the event of any inconsistency between the Agreement and this Second Amendment, this Second Amendment shall control. All references in the Agreement to the "Agreement" shall hereafter be deemed references to the Agreement as amended by this Second Amendment. The Agreement, as amended hereby, is hereby reaffirmed by the Parties' signatures hereto.

10. In all other respects, the Agreement (as previously amended) remains in full force and effect, unchanged.

11. Capitalized terms used but not otherwise defined in this Second Amendment shall have the meanings assigned to them in the Agreement.

12. This Second Amendment may be executed in one or more counterpart, each of which shall be deemed an original and all of which combined shall the same instrument. Facsimile and/or electronic copies of the Parties' signatures shall be valid and treated the same as original signatures.

IN WITNESS WHEREOF, the parties have caused this Second Amendment to be duly executed intending to be bound thereby.

[SIGNATURE PAGE FOLLOWS]

THE COUNTY OF GLOUCESTER, VIRGINIA:

By: _____
Robert J. Orth
Chairman, Board of Supervisors

APPROVED AS TO FORM:

By: _____
Edwin N. Wilmot
County Attorney

WASTE MANAGEMENT DISPOSAL SERVICES OF VIRGINIA, INC.:

By: _____

Name: Ronald S. Ward

Title: Asst Area Vice President

ATTACHMENT 1 to SECOND AMENDMENT

EXHIBIT K

		Biographical Information		Weekly Service Level			
	W/S Account #	Service Name	House # and Street Name	Container Quantity	Container Size	Weekly Frequency	Total Route
	425-4448	Gloucester Animal Shelter	6584 Beehive Drive	1	8yd	1	1
	425-3022	Gloucester Beaver Dam Park	8687 Roaring Springs Road	1	6yd	2	2
*	425 7065	Gloucester Point Boat Landing	Coleman Bridge	1	8yd	2	2
	425-43482	Gloucester Fire Station	7598 Dutton Road	1	2yd	on call	0
	425-1604	Transportation Garage	6644 George Washingt onMem	1	6yd	2	2
	425-1600	Petsworth Elementary School	10648 Geor geWashington Mem	2	6yd	3	6
	425-3021	Gloucester Point Beach	1255 Greate Road	1	8yd	4	4
	425-1603	Peasley Middle School	2885 Hickory Fork Road	3	6yd	3	9
	425-6964	Bethel Elementary School	2991 Hickory Fork Road	2	8yd	3	6
	425-256	Gloucester County Jail	7502 Just iceDrive	2	8yd	3	6
	425-1598	Botetourt Elementary School	6361 Main Street	3	6yd	2	6
	425-5818	Area Agency on Aging	6650 Main Street	1	6yd	1	1
	425-2453	Waste Water Treatment Plant	6936 Main Street	1	6yd	1	1
	425-6272	Gloucester Cty Youth Baseball	Rt 17	1	4yd	2	2
	425-202	Social Service s	6641 Short Lane	1	6yd	1	1
	425-1602	Gloucester High School	6680 Short Lane	6	6yd	3	18
	425-1602	Gloucester High School	6680 Short Lane	1	8yd	3	3
	425-1005	Gloucester Cty Water Treatment	Spring Hill Farm Road	1	6yd	1	1
	425-61941	Page Middle School	5198 T C Walker Road	2	8yd	3	6
	425-48768	Gloucester County HS - Maintence	6097 TC Walker Road	1	8yd	1	1
	425-1601	TC Walker Elementary School	6099 TC Walker Road	2	6yd	3	6
	425-68356	WM Middle Peninsula FL	7363 Walker Avenue	1	8yd	1	1
	425-5444	Warehouse Boat Landing	Warehouse Road	1	8yd	3	3
	425-1596	Achilles Elementary School	9306 Guinea Rd	2	6yd	3	6
	425 1597	Abingdon Elementary School	7087 Powhatan Dr	2	6yd	3	6
			TOTAL BOXES	41		Weekly Hauls:	100

* Yellow highlighted account is seasonal April 1 through Sep 30

Attachment 6

Stormwater Analysis

[AS PER THE PART B MAJOR PERMIT MODIFICATION DATED AUGUST 2021, SEDIMENT BASINS ARE RENUMERED IN ACCORDANCE WITH THE TABLE BELOW]

Basin Pre-2021 Permit Modification	Basin Post-2021 Permit Modification
Basin 3	Forebay
Borrow Area	Basin 6
Basin 4	Basin 5
Basin 5	Basin 10
Basin 6	Basin 12
Basin 7	Basin 11
Basin 8	Basin 13

Attachment 7

Working Face and Traffic Queuing Analysis

Calculations for Traffic Queuing Analysis Entrance Road

Average Daily Intake Rate	2,400	tons/day
Maximum Daily Intake Rate	4,000	tons/day
Maximum Size Vehicle	20	tons
Average Work Day	9.5	hours
On-site Road Length from Entrance to Scales	1,000	feet

Average Waste Intake, Average Hourly Usage

Average Hourly Use	253	tons/hour
Average Size Vehicle Delivery Rate	13	loads/hour
Average Size Vehicle Arrival Rate	4.75	minutes/load
Maximum time to weigh/inspect per truck	3.00	minutes/load
Maximum number of weigh/inspect areas	1.00	areas
Equivalent time to weigh/inspect per truck	3.00	minutes/load

Peak Waste Intake, Maximum Hourly Usage

Peak Maximum Hourly Use	421	tons/hour
Peak Size Vehicle Delivery Rate	21	loads/hour
Peak Size Vehicle Arrival Rate	2.85	minutes/load
Maximum time to weigh/inspect per truck	3.00	minutes/load
Maximum number of weigh/inspect areas	1.00	areas
Equivalent time to weigh/inspect per truck	3.00	minutes/load

Assume 2 peak use hours between 7:00 a.m. and 9:00 a.m. at 421 tons/hour, then followed by average use hours at 253 tons/hour for the remainder of the work day. Determine the time to weigh/inspect vehicles and the required road queuing length.

Vehicle	Arrival Time	Processing Time	End Processing	Trucks In Queue	Required Length
1	7:00:00 AM	0:03:00	7:03:00 AM	0	0
2	7:02:51 AM	0:03:09	7:06:00 AM	1	50
3	7:05:42 AM	0:03:18	7:09:00 AM	1	50
4	7:08:33 AM	0:03:27	7:12:00 AM	1	50
5	7:11:24 AM	0:03:36	7:15:00 AM	1	50
6	7:14:15 AM	0:03:45	7:18:00 AM	1	50
7	7:17:06 AM	0:03:54	7:21:00 AM	1	50
8	7:19:57 AM	0:04:03	7:24:00 AM	1	50
9	7:22:48 AM	0:04:12	7:27:00 AM	1	50
10	7:25:39 AM	0:04:21	7:30:00 AM	1	50
11	7:28:30 AM	0:04:30	7:33:00 AM	1	50
12	7:31:21 AM	0:04:39	7:36:00 AM	1	50
13	7:34:12 AM	0:04:48	7:39:00 AM	1	50
14	7:37:03 AM	0:04:57	7:42:00 AM	1	50
15	7:39:54 AM	0:05:06	7:45:00 AM	1	50

Made By: ANG
Checked: SDRM
Reviewed: JRD

16	7:42:45 AM	0:05:15	7:48:00 AM	1	50
17	7:45:36 AM	0:05:24	7:51:00 AM	1	50
18	7:48:27 AM	0:05:33	7:54:00 AM	1	50
19	7:51:18 AM	0:05:42	7:57:00 AM	1	50
20	7:54:09 AM	0:05:51	8:00:00 AM	1	50
21	7:57:00 AM	0:06:00	8:03:00 AM	1	50
22	7:59:51 AM	0:06:09	8:06:00 AM	2	100
23	8:02:42 AM	0:06:18	8:09:00 AM	2	100
24	8:05:33 AM	0:06:27	8:12:00 AM	2	100
25	8:08:24 AM	0:06:36	8:15:00 AM	2	100
26	8:11:15 AM	0:06:45	8:18:00 AM	2	100
27	8:14:06 AM	0:06:54	8:21:00 AM	2	100
28	8:16:57 AM	0:07:03	8:24:00 AM	2	100
29	8:19:48 AM	0:07:12	8:27:00 AM	2	100
30	8:22:39 AM	0:07:21	8:30:00 AM	2	100
31	8:25:30 AM	0:07:30	8:33:00 AM	2	100
32	8:28:21 AM	0:07:39	8:36:00 AM	2	100
33	8:31:12 AM	0:07:48	8:39:00 AM	2	100
34	8:34:03 AM	0:07:57	8:42:00 AM	2	100
35	8:36:54 AM	0:08:06	8:45:00 AM	2	100
36	8:39:45 AM	0:08:15	8:48:00 AM	2	100
37	8:42:36 AM	0:08:24	8:51:00 AM	2	100
38	8:45:27 AM	0:08:33	8:54:00 AM	2	100
39	8:48:18 AM	0:08:42	8:57:00 AM	2	100
40	8:51:09 AM	0:08:51	9:00:00 AM	2	100
41	8:54:00 AM	0:09:00	9:03:00 AM	2	100
42	8:56:51 AM	0:09:09	9:06:00 AM	3	150
43	9:01:36 AM	0:07:24	9:09:00 AM	2	100
44	9:06:21 AM	0:05:39	9:12:00 AM	1	50
45	9:11:06 AM	0:03:54	9:15:00 AM	1	50
46	9:15:51 AM	0:03:00	9:18:51 AM	0	0
47	9:20:36 AM	0:03:00	9:23:36 AM	0	0
48	9:25:21 AM	0:03:00	9:28:21 AM	0	0
49	9:30:06 AM	0:03:00	9:33:06 AM	0	0
50	9:34:51 AM	0:03:00	9:37:51 AM	0	0
51	9:39:36 AM	0:03:00	9:42:36 AM	0	0
52	9:44:21 AM	0:03:00	9:47:21 AM	0	0
53	9:49:06 AM	0:03:00	9:52:06 AM	0	0
54	9:53:51 AM	0:03:00	9:56:51 AM	0	0
55	9:58:36 AM	0:03:00	10:01:36 AM	0	0
56	10:03:21 AM	0:03:00	10:06:21 AM	0	0
57	10:08:06 AM	0:03:00	10:11:06 AM	0	0
58	10:12:51 AM	0:03:00	10:15:51 AM	0	0
59	10:17:36 AM	0:03:00	10:20:36 AM	0	0
60	10:22:21 AM	0:03:00	10:25:21 AM	0	0

61	10:27:06 AM	0:03:00	10:30:06 AM	0	0
62	10:31:51 AM	0:03:00	10:34:51 AM	0	0
63	10:36:36 AM	0:03:00	10:39:36 AM	0	0
64	10:41:21 AM	0:03:00	10:44:21 AM	0	0
65	10:46:06 AM	0:03:00	10:49:06 AM	0	0
66	10:50:51 AM	0:03:00	10:53:51 AM	0	0
67	10:55:36 AM	0:03:00	10:58:36 AM	0	0
68	11:00:21 AM	0:03:00	11:03:21 AM	0	0
69	11:05:06 AM	0:03:00	11:08:06 AM	0	0
70	11:09:51 AM	0:03:00	11:12:51 AM	0	0
71	11:14:36 AM	0:03:00	11:17:36 AM	0	0
72	11:19:21 AM	0:03:00	11:22:21 AM	0	0
73	11:24:06 AM	0:03:00	11:27:06 AM	0	0
74	11:28:51 AM	0:03:00	11:31:51 AM	0	0
75	11:33:36 AM	0:03:00	11:36:36 AM	0	0
76	11:38:21 AM	0:03:00	11:41:21 AM	0	0
77	11:43:06 AM	0:03:00	11:46:06 AM	0	0
78	11:47:51 AM	0:03:00	11:50:51 AM	0	0
79	11:52:36 AM	0:03:00	11:55:36 AM	0	0
80	11:57:21 AM	0:03:00	12:00:21 PM	0	0
81	12:02:06 PM	0:03:00	12:05:06 PM	0	0
82	12:06:51 PM	0:03:00	12:09:51 PM	0	0
83	12:11:36 PM	0:03:00	12:14:36 PM	0	0
84	12:16:21 PM	0:03:00	12:19:21 PM	0	0
85	12:21:06 PM	0:03:00	12:24:06 PM	0	0
86	12:25:51 PM	0:03:00	12:28:51 PM	0	0
87	12:30:36 PM	0:03:00	12:33:36 PM	0	0
88	12:35:21 PM	0:03:00	12:38:21 PM	0	0
89	12:40:06 PM	0:03:00	12:43:06 PM	0	0
90	12:44:51 PM	0:03:00	12:47:51 PM	0	0
91	12:49:36 PM	0:03:00	12:52:36 PM	0	0
92	12:54:21 PM	0:03:00	12:57:21 PM	0	0
93	12:59:06 PM	0:03:00	1:02:06 PM	0	0
94	1:03:51 PM	0:03:00	1:06:51 PM	0	0
95	1:08:36 PM	0:03:00	1:11:36 PM	0	0
96	1:13:21 PM	0:03:00	1:16:21 PM	0	0
97	1:18:06 PM	0:03:00	1:21:06 PM	0	0
98	1:22:51 PM	0:03:00	1:25:51 PM	0	0
99	1:27:36 PM	0:03:00	1:30:36 PM	0	0
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101	1:37:06 PM	0:03:00	1:40:06 PM	0	0
102	1:41:51 PM	0:03:00	1:44:51 PM	0	0
103	1:46:36 PM	0:03:00	1:49:36 PM	0	0
104	1:51:21 PM	0:03:00	1:54:21 PM	0	0
105	1:56:06 PM	0:03:00	1:59:06 PM	0	0

Made By: ANG
Checked: SDRM
Reviewed: JRD

106	2:00:51 PM	0:03:00	2:03:51 PM	0	0
107	2:05:36 PM	0:03:00	2:08:36 PM	0	0
108	2:10:21 PM	0:03:00	2:13:21 PM	0	0
109	2:15:06 PM	0:03:00	2:18:06 PM	0	0
110	2:19:51 PM	0:03:00	2:22:51 PM	0	0
111	2:24:36 PM	0:03:00	2:27:36 PM	0	0
112	2:29:21 PM	0:03:00	2:32:21 PM	0	0
113	2:34:06 PM	0:03:00	2:37:06 PM	0	0
114	2:38:51 PM	0:03:00	2:41:51 PM	0	0
115	2:43:36 PM	0:03:00	2:46:36 PM	0	0
116	2:48:21 PM	0:03:00	2:51:21 PM	0	0
117	2:53:06 PM	0:03:00	2:56:06 PM	0	0
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120	3:07:21 PM	0:03:00	3:10:21 PM	0	0
121	3:12:06 PM	0:03:00	3:15:06 PM	0	0
122	3:16:51 PM	0:03:00	3:19:51 PM	0	0
123	3:21:36 PM	0:03:00	3:24:36 PM	0	0
124	3:26:21 PM	0:03:00	3:29:21 PM	0	0
125	3:31:06 PM	0:03:00	3:34:06 PM	0	0
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127	3:40:36 PM	0:03:00	3:43:36 PM	0	0
128	3:45:21 PM	0:03:00	3:48:21 PM	0	0
129	3:50:06 PM	0:03:00	3:53:06 PM	0	0
130	3:54:51 PM	0:03:00	3:57:51 PM	0	0
131	3:59:36 PM	0:03:00	4:02:36 PM	0	0
132	4:04:21 PM	0:03:00	4:07:21 PM	0	0
133	4:09:06 PM	0:03:00	4:12:06 PM	0	0
134	4:13:51 PM	0:03:00	4:16:51 PM	0	0
135	4:18:36 PM	0:03:00	4:21:36 PM	0	0
136	4:23:21 PM	0:03:00	4:26:21 PM	0	0

Calculations for Traffic Queuing Analysis On-Site Road

Average Daily Intake Rate	2,400	tons/day
Maximum Daily Intake Rate	4,000	tons/day
Maximum Size Vehicle	20	tons
Average Work Day	9.5	hours
On-site Road Length from Scales to Working Face	2,200	feet

Average Waste Intake, Average Hourly Usage

Average Hourly Use at Scales	253	tons/hour
Average Size Vehicle Delivery Rate at Scales	13	loads/hour
Average Size Vehicle Arrival Rate from Scales	4.75	minutes/load
Maximum time to unload per truck	18.00	minutes/load
Maximum number of unloading areas	4.00	areas
Equivalent time to unload per truck	4.50	minutes/load

Peak Waste Intake, Maximum Hourly Usage

Peak Maximum Hourly Use at Scales	421	tons/hour	
Peak Size Vehicle Delivery Rate at Scales	21	loads/hour	
Peak Size Vehicle Arrival Rate from Scales	2.85	minutes/load	
Maximum time to unload per truck	18.00	minutes/load	
Maximum number of unloading areas	6.00	areas	max. 6
Equivalent time to unload per truck	3.00	minutes/load	

Assume 2 peak use hours between 7:00 a.m. and 9:00 a.m. at 421 tons/hour, then followed by average use hours at 253 tons/hour for the remainder of the work day. Determine the time to unload vehicles and the required road queuing length.

Vehicle	Arrival Time	Processing Time	End Processing	Trucks In Queue	Required Length
1	7:01:00 AM	0:03:00	7:04:00 AM	0	0
2	7:03:51 AM	0:03:09	7:07:00 AM	1	50
3	7:06:42 AM	0:03:18	7:10:00 AM	1	50
4	7:09:33 AM	0:03:27	7:13:00 AM	1	50
5	7:12:24 AM	0:03:36	7:16:00 AM	1	50
6	7:15:15 AM	0:03:45	7:19:00 AM	1	50
7	7:18:06 AM	0:03:54	7:22:00 AM	1	50
8	7:20:57 AM	0:04:03	7:25:00 AM	1	50
9	7:23:48 AM	0:04:12	7:28:00 AM	1	50
10	7:26:39 AM	0:04:21	7:31:00 AM	1	50
11	7:29:30 AM	0:04:30	7:34:00 AM	1	50
12	7:32:21 AM	0:04:39	7:37:00 AM	1	50
13	7:35:12 AM	0:04:48	7:40:00 AM	1	50
14	7:38:03 AM	0:04:57	7:43:00 AM	1	50
15	7:40:54 AM	0:05:06	7:46:00 AM	1	50

Made By: ANG
Checked: SDRM
Reviewed: JRD

16	7:43:45 AM	0:05:15	7:49:00 AM	1	50
17	7:46:36 AM	0:05:24	7:52:00 AM	1	50
18	7:49:27 AM	0:05:33	7:55:00 AM	1	50
19	7:52:18 AM	0:05:42	7:58:00 AM	1	50
20	7:55:09 AM	0:05:51	8:01:00 AM	1	50
21	7:58:00 AM	0:06:00	8:04:00 AM	1	50
22	8:00:51 AM	0:06:09	8:07:00 AM	2	100
23	8:03:42 AM	0:06:18	8:10:00 AM	2	100
24	8:06:33 AM	0:06:27	8:13:00 AM	2	100
25	8:09:24 AM	0:06:36	8:16:00 AM	2	100
26	8:12:15 AM	0:06:45	8:19:00 AM	2	100
27	8:15:06 AM	0:06:54	8:22:00 AM	2	100
28	8:17:57 AM	0:07:03	8:25:00 AM	2	100
29	8:20:48 AM	0:07:12	8:28:00 AM	2	100
30	8:23:39 AM	0:07:21	8:31:00 AM	2	100
31	8:26:30 AM	0:07:30	8:34:00 AM	2	100
32	8:29:21 AM	0:07:39	8:37:00 AM	2	100
33	8:32:12 AM	0:07:48	8:40:00 AM	2	100
34	8:35:03 AM	0:07:57	8:43:00 AM	2	100
35	8:37:54 AM	0:08:06	8:46:00 AM	2	100
36	8:40:45 AM	0:08:15	8:49:00 AM	2	100
37	8:43:36 AM	0:08:24	8:52:00 AM	2	100
38	8:46:27 AM	0:08:33	8:55:00 AM	2	100
39	8:49:18 AM	0:08:42	8:58:00 AM	2	100
40	8:52:09 AM	0:08:51	9:01:00 AM	2	100
41	8:55:00 AM	0:09:00	9:04:00 AM	2	100
42	8:57:51 AM	0:09:09	9:07:00 AM	3	150
43	9:02:36 AM	0:08:54	9:11:30 AM	3	150
44	9:07:21 AM	0:08:39	9:16:00 AM	2	100
45	9:12:06 AM	0:08:24	9:20:30 AM	1	50
46	9:16:51 AM	0:08:09	9:25:00 AM	1	50
47	9:21:36 AM	0:07:54	9:29:30 AM	1	50
48	9:26:21 AM	0:07:39	9:34:00 AM	1	50
49	9:31:06 AM	0:07:24	9:38:30 AM	1	50
50	9:35:51 AM	0:07:09	9:43:00 AM	1	50
51	9:40:36 AM	0:06:54	9:47:30 AM	1	50
52	9:45:21 AM	0:06:39	9:52:00 AM	1	50
53	9:50:06 AM	0:06:24	9:56:30 AM	1	50
54	9:54:51 AM	0:06:09	10:01:00 AM	1	50
55	9:59:36 AM	0:05:54	10:05:30 AM	1	50
56	10:04:21 AM	0:05:39	10:10:00 AM	1	50
57	10:09:06 AM	0:05:24	10:14:30 AM	1	50
58	10:13:51 AM	0:05:09	10:19:00 AM	1	50
59	10:18:36 AM	0:04:54	10:23:30 AM	1	50
60	10:23:21 AM	0:04:39	10:28:00 AM	1	50

61	10:28:06 AM	0:04:30	10:32:36 AM	0	0
62	10:32:51 AM	0:04:30	10:37:21 AM	0	0
63	10:37:36 AM	0:04:30	10:42:06 AM	0	0
64	10:42:21 AM	0:04:30	10:46:51 AM	0	0
65	10:47:06 AM	0:04:30	10:51:36 AM	0	0
66	10:51:51 AM	0:04:30	10:56:21 AM	0	0
67	10:56:36 AM	0:04:30	11:01:06 AM	0	0
68	11:01:21 AM	0:04:30	11:05:51 AM	0	0
69	11:06:06 AM	0:04:30	11:10:36 AM	0	0
70	11:10:51 AM	0:04:30	11:15:21 AM	0	0
71	11:15:36 AM	0:04:30	11:20:06 AM	0	0
72	11:20:21 AM	0:04:30	11:24:51 AM	0	0
73	11:25:06 AM	0:04:30	11:29:36 AM	0	0
74	11:29:51 AM	0:04:30	11:34:21 AM	0	0
75	11:34:36 AM	0:04:30	11:39:06 AM	0	0
76	11:39:21 AM	0:04:30	11:43:51 AM	0	0
77	11:44:06 AM	0:04:30	11:48:36 AM	0	0
78	11:48:51 AM	0:04:30	11:53:21 AM	0	0
79	11:53:36 AM	0:04:30	11:58:06 AM	0	0
80	11:58:21 AM	0:04:30	12:02:51 PM	0	0
81	12:03:06 PM	0:04:30	12:07:36 PM	0	0
82	12:07:51 PM	0:04:30	12:12:21 PM	0	0
83	12:12:36 PM	0:04:30	12:17:06 PM	0	0
84	12:17:21 PM	0:04:30	12:21:51 PM	0	0
85	12:22:06 PM	0:04:30	12:26:36 PM	0	0
86	12:26:51 PM	0:04:30	12:31:21 PM	0	0
87	12:31:36 PM	0:04:30	12:36:06 PM	0	0
88	12:36:21 PM	0:04:30	12:40:51 PM	0	0
89	12:41:06 PM	0:04:30	12:45:36 PM	0	0
90	12:45:51 PM	0:04:30	12:50:21 PM	0	0
91	12:50:36 PM	0:04:30	12:55:06 PM	0	0
92	12:55:21 PM	0:04:30	12:59:51 PM	0	0
93	1:00:06 PM	0:04:30	1:04:36 PM	0	0
94	1:04:51 PM	0:04:30	1:09:21 PM	0	0
95	1:09:36 PM	0:04:30	1:14:06 PM	0	0
96	1:14:21 PM	0:04:30	1:18:51 PM	0	0
97	1:19:06 PM	0:04:30	1:23:36 PM	0	0
98	1:23:51 PM	0:04:30	1:28:21 PM	0	0
99	1:28:36 PM	0:04:30	1:33:06 PM	0	0
100	1:33:21 PM	0:04:30	1:37:51 PM	0	0
101	1:38:06 PM	0:04:30	1:42:36 PM	0	0
102	1:42:51 PM	0:04:30	1:47:21 PM	0	0
103	1:47:36 PM	0:04:30	1:52:06 PM	0	0
104	1:52:21 PM	0:04:30	1:56:51 PM	0	0
105	1:57:06 PM	0:04:30	2:01:36 PM	0	0

106	2:01:51 PM	0:04:30	2:06:21 PM	0	0
107	2:06:36 PM	0:04:30	2:11:06 PM	0	0
108	2:11:21 PM	0:04:30	2:15:51 PM	0	0
109	2:16:06 PM	0:04:30	2:20:36 PM	0	0
110	2:20:51 PM	0:04:30	2:25:21 PM	0	0
111	2:25:36 PM	0:04:30	2:30:06 PM	0	0
112	2:30:21 PM	0:04:30	2:34:51 PM	0	0
113	2:35:06 PM	0:04:30	2:39:36 PM	0	0
114	2:39:51 PM	0:04:30	2:44:21 PM	0	0
115	2:44:36 PM	0:04:30	2:49:06 PM	0	0
116	2:49:21 PM	0:04:30	2:53:51 PM	0	0
117	2:54:06 PM	0:04:30	2:58:36 PM	0	0
118	2:58:51 PM	0:04:30	3:03:21 PM	0	0
119	3:03:36 PM	0:04:30	3:08:06 PM	0	0
120	3:08:21 PM	0:04:30	3:12:51 PM	0	0
121	3:13:06 PM	0:04:30	3:17:36 PM	0	0
122	3:17:51 PM	0:04:30	3:22:21 PM	0	0
123	3:22:36 PM	0:04:30	3:27:06 PM	0	0
124	3:27:21 PM	0:04:30	3:31:51 PM	0	0
125	3:32:06 PM	0:04:30	3:36:36 PM	0	0
126	3:36:51 PM	0:04:30	3:41:21 PM	0	0
127	3:41:36 PM	0:04:30	3:46:06 PM	0	0
128	3:46:21 PM	0:04:30	3:50:51 PM	0	0
129	3:51:06 PM	0:04:30	3:55:36 PM	0	0
130	3:55:51 PM	0:04:30	4:00:21 PM	0	0
131	4:00:36 PM	0:04:30	4:05:06 PM	0	0
132	4:05:21 PM	0:04:30	4:09:51 PM	0	0
133	4:10:06 PM	0:04:30	4:14:36 PM	0	0
134	4:14:51 PM	0:04:30	4:19:21 PM	0	0
135	4:19:36 PM	0:04:30	4:24:06 PM	0	0
136	4:24:21 PM	0:04:30	4:28:51 PM	0	0